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RECTIFIER OF THERMALLY MOVING ELECTRONS AND METHOD FOR CONVERTING THERMAL ENERGY INTO ELECTRIC ENERGY BY USING THE SAME

Technical Field

The present invention relates to a rectifier and a method for converting heat of a body into electric energy by utilizing a function of rectifying thermally moving electrons within a body by means of a rectifying surface of current comprised of an aggregate of minute rectifying surfaces having one rectifying direction.

Background Art

Various energy forms such as potential energy, kinetic energy, electric energy, light energy and thermal energy are present in nature and these energy form's are converted into another one as needed. Human beings have longed for a conversion of thermal energy into another energy forms without a low temperature heat source, however, this conversion has not been accomplished so far. In nature, the finally converted energy form is thermal energy and the conversion of thermal energy into another forms is prohibited as defined by the second law of thermodynamics. If a method for converting the thermal energy into another energy without the low temperature heat source is found, human beings can acquire inexhaustible, inexpensive and pollution free energy. Thus, the problem of energy source, global warming and pollution that the humanity is faced with can be solved. Further, insufficient area in the

second law of thermodynamics can be improved to strengthen the foundations of the modern science.

Disclosure of Invention

Accordingly, it is an object in the present invention to provide a novel rectifier of thermally moving electrons, which can rectify random movements of the thermally moving electrons into one directional movement and by which a direct conversion of thermal energy into electric energy without a separate heat source and a conversion of thermal energy into electric energy without a low temperature heat source are accomplished.

Another object of the present invention is to provide a method for converting thermal energy into electric energy by using the rectifier.

To accomplish the above object, there is provided in the present invention a rectifier of thermally moving electrons comprising a first metal layer, an electron movement barrier layer contacting to the first metal layer, and distributed layer of minute metal particles contacting the electron movement barrier layer. The rectifier also includes a semiconductor layer contacting the distributed layer of minute metal particles, an ohmic layer contacting the semiconductor layer, and a second metal layer contacting the ohmic layer. The second metal layer comprises an aggregate of minute rectifying surfaces.

The minute rectifying surfaces have a same rectifying direction and are electrically isolated from each other. Further, the rectifying surfaces are incompletely

conductive (barrier state) with one collimating electrode.

A method for converting thermal energy into electric energy by rectifying thermally moving electrons by implementing a rectifier of thermally moving electrons, utilizes a rectifying surface of an aggregate of minute rectifying surfaces to rectify each thermally moving electron and to change the random moving directions of the electrons into one direction for accomplishing the energy conversion.

Brief Description of Drawings

The above objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a cross-sectional view of a rectifier of thermally moving electrons according to an embodiment of the present invention;

FIG. 2 is an apparatus for converting thermal energy into electric energy according to an embodiment of the present invention;

FIG. 3 illustrates a graph for showing a relationship between a diameter of a minute rectifying surface (X-axis, unit; nm=10Å) and a voltage generated by a charge of one electron (Y-axis) when the minute rectifying surface is circular, dielectric constant is $\varepsilon=8$, and a common condenser having a distance of 31Å was utilized; and

FIG. 4 illustrates a graph for showing a relationship between energy of electrons (X-axis, unit; kT) and a voltage generated by the energy (Y-axis) at room temperature.

Best Mode for Carrying Out the Invention

Hereinafter, the present invention will be explained in more detail with reference to the accompanying drawings.

The uses and applications of the present invention are hoped to offer viable solutions for the current and prevailing problems with energy, global warming, and pollution.

The inventor of the present invention observed that power was generated from a semiconductor surface on which minute metal particles were dispersed without a supply of energy, and found that the power was originated from rectifying phenomenon of thermally moving electrons. The present invention shows that the rectifying phenomenon could be elucidated and reproduced by the present scientific knowledge.

It is known that atomic vibrations exist in physical objects above 0° of absolute temperature and the atomic vibrations in turn induce vibrations of electrons in conductors or semiconductors. Minute rectifying surfaces in conductors and semiconductors having one rectifying direction and a diameter of from several to twenty nanometers are insulated from each other and the minute rectifying surfaces and one collimating electrode are in incomplete conductive state (barrier state). Electrons having different phases and periods are rectified by the rectifying surfaces toward the collimating electrode, and at this time, the thermal energy of thermally moving electrons are converted into electric energy. Here, the thermal energy of the thermally moving electrons is thermal energy of an object and thus, it was determined that the heat of an object can be converted into electric energy.

Sub B1

~~There's no prior art in this field, and the accomplishment of the present invention~~

Sub a' (cont'd)

contradicts the second law of of thermodynamics. It is anticipated that very few scholars in the field will deny the second law of thermodynamics.

All of the applications and effects of the present invention cannot be illustrated by the present inventor at this time, however, it will be evident that those applications described by the present invention contradicts the second law of thermodynamics. If the second law of thermodynamics is lasting and permanent, most experts in the field will agree that the future of the living things on the earth is gloomy. If the present invention is confirmed and a new simultaneous theory suggested by the present inventor is approved, their implications will have drastic and lasting impact on the future of humanity, such as their applications can be realized in an internal-combustion engine and humanity will be set free from the problem of energy. It is also anticipated that the implications of the present invention will affect the social structure and individuals while having both of positive and negative results.

The present invention is difficult to understand and explain by the present scientific knowledge and existing theories, since the nature of the invention is truly novel and contradicts the second law of thermodynamics. When a thermally moving electron is rectified by a rectifying surface in state of equilibrium, the temperature at the surface must be lowered according to the law of conservation energy. However, the phenomenon described by the present invention contradicts the second law of thermodynamics by which the natural phenomenon is set to proceed toward equilibrium. The present invention shows that power and temperature difference exists without a supply of external energy.

By repeated experiments of the present invention, a generation of electric energy was observed when minute metal particles are dispersed on a surface of a semiconductor.

The second law of thermodynamics is one of the most important criteria for determining the truth or falsehood of inventions related to thermodynamics. Hence, the inventor realizes the difficulty faced by various Patent Offices and makes reference to the second law of thermodynamics in so far as to help explain the new theory set forth in the present invention, which will be described below. In addition, experimental results which support the principle of this theory will be illustrated.

The experiment is simple and any one skilled in this field can understand and carry out the experiment easily. However, the interpretation of the experiment based on the modern scientific knowledge is not an easy task, and only the simultaneous theory established by the present inventor can interpret the results of the experiment.

The experiment will be described briefly below.

When minute metal particles were dispersed on the surface of a semiconductor and an aluminum needle coated with a naturally formed oxide layer contacted the surface, an electromotive force was generated between the needle and the semiconductor. The detected current was more than 20 amperes/cm^2 and the detected voltage was more than 150 mV. This result was obtained without an electrolyte and could not be explained with existing scientific theories. After experiencing this peculiar phenomenon, several experiments having the same conditions were conducted to verify the cause and to reproduce the obtained values. The electromotive forces were

detected from all of the semiconductors utilized for experiments even though the same values were not obtained. The detected values were less than 1mV.

One noticeable thing which drew interest was a continuous output of energy without an external supply of energy. From the observed results of repeated experiments, the present inventor found that the output of the energy had originated from a rectifying phenomenon of thermally moving electrons themselves at minute rectifying surfaces, which contradicts the second law of thermodynamics.

After, the present inventor set out to detect the temperature of the surface of the semiconductor where the electromotive force has been generated and as a result, the conversion of heat of an object into electric energy by the rectifying phenomenon of thermally moving electrons at the rectifying surface could be verified. This experimental observation was reproducible.

The inventor has established the following items as bases of experiments carried out for verifying the simultaneous theory suggested by the present invention and to determine the direction of experiments.

1. An electromotive force is generated from a surface of a semiconductor on which minute metal particles which are not consumed in the experiment are dispersed.

2. The voltage value of the electromotive force is in a close relation with the size of the metal particles.

3. A continuous and constant current is obtained from a structure which has the same structure with a chemical battery but has no consuming material, and thus obtained current value per unit area is even larger than that obtained by the chemical

battery.

4. The direction of the electromotive force is determined by a conductivity of P or N of a semiconductor.

5. The direction of the electromotive force changes to its counter direction in a vacuum and under atmospheric ambient. The same kind of electromotive force is found in an electrolyte or in water. Self-inherent conductive type electromotive force is obtained in a high vacuum.

Sub a2

~~6. In a battery having one electrode made of copper plate coated with copper sulfide, the other electrode made of copper plate and an electrolyte of copper(II) sulfate, the copper plate becomes positive(+) electrode. Copper is precipitated during discharging and copper particles grow on the negative electrode at the portion where the copper plate is exposed, without a supply of external power. After implementing various methods, it was found that the surface of copper sulfide is positive(+) electrode and an inner portion of copper sulfide contacting the copper plate is a generator of a negative electrode and the copper plate of the negative electrode is a mere metal plate contacting the generator. The electrolysis of copper at both electrodes are implemented by the electromotive power outputted from the generator. The present inventor found that the outputted energy was originated from the rectifying phenomenon of thermally moving electrons. By utilizing this apparatus, a temperature drop at the portion where the electromotive force was generated, could be detected. Further, the conversion of heat of an object into electric energy by the rectifying method utilizing the thermally moving electrons can be verified.~~

7. When comparing the electromotive force with ambient conditions, two electromotive forces conflicting with each other seems to be present and one electromotive force is superior to the other according to the ambient conditions (especially in humidity). That is, the relative numbers of acceptor and donor depend on the ambient conditions.

The above-described items were confirmed by many experiments carried out in the present invention except for item 6.

Experimental procedure is as follows. A metal was rubbed against a surface of a semiconductor or was deposited in a vacuum to form an island structure on the surface of the semiconductor and then an electromotive force was detected by an aluminum needle coated with an oxide layer. Onto the naturally formed oxide layer of aluminum or tantalum, metal particles were deposited by an evaporation method in a vacuum and a semiconductor was deposited onto the metal particles. For various samples, some characteristics such as temperature drop, voltage and current were detected at the portion where the electromotive force was generated. However, experiments concerning the size of the metal particles could not be reproduced by an apparatus utilized by the present inventor.

The experiments were carried out in a vacuum, under atmosphere, in water and in an electrolyte.

Sub a3

The relationship of the electromotive force to the size of the metal particles and the problem of non-reproductiveness of the voltage value were solved only in the electrolyte and water. Although some problems of interference of the chemical

Sub a3 (cont'd)

electromotive force occur for these cases, the relationship of the size of the minute metal particles to the amount of the current can be obtained. In addition, the size of the metal particles can be controlled while reading the values of the electromotive force. There's other various advantages accompanying the experiments in the electrolyte or water. Different from the experiments implemented in the vacuum or under atmosphere, the electrolyte or water becomes a barrier layer in this experiments.

Experiment for item 6 will be described below. In order to offset the chemical electromotive force, two copper electrodes having high purity of up to 99.9% were utilized.

One copper electrode was coated with copper sulfide CuS, which was a semiconductor having P-type conductivity, by impregnating the electrode with an ammonium sulfide [$(NH_4)_2S_x$] solution diluted by five times for about 40 seconds. The other electrode was utilized as a pure copper plate and copper sulfate ($CuSO_4$) was utilized as an electrolyte. After completing assembling a battery, the pure copper plate should be an anode by an electrochemical theory. Copper of the copper plate should be ionized into Cu^{++} ion to be the electrolyte while Cu^{++} ion in the electrolyte is combined with excessive sulfide present in copper sulfide. Thus, the electrode of the copper plate should be the anode while the copper sulfide electrode being a cathode. In fact, when copper sulfide electrode stored under atmosphere or in water for a long time is utilized for the manufacture of a battery having the same structure described above, above-described result is obtained.

However, the result described in item 6 was obtained by the present invention.

With an output of the electromotive force, the temperature of the battery decreased and copper precipitated at both electrodes. This phenomenon did not proceed toward equilibrium but rather in opposite direction of equilibrium. That is, this result did not correspond to the second law of thermodynamics. The oxide layer on the surface of Ta metal functions a stable tunneling in the electrolyte.

Sub A4

~~The copper sulfide electrode was replaced with an electrolyte manufactured by the following method. Cu was deposited in a vacuum on the surface of Ta metal plate. Then, thus obtained metal plate was immersed into an aqueous $CuSO_4$ solution for electroplating copper onto the surface to obtain about 0.02mm thick copper layer. After rinsing with water, the copper coated plate was impregnated with $(NH_4)_2S_x$ solution for 5 minutes to change copper into copper sulfide. Thus obtained sample was replaced with the copper sulfide electrode of the previously described battery. As a result, almost similar value of the electromotive force was obtained. When copper sulfide was employed as an anode and an electroplating with a relatively low current of $50mA/12cm^2$ for 60 seconds was carried out to form minute metal particles on the surface of copper sulfide, the voltage increased. Various experiments utilizing this battery was implemented as follows. A reverse current was provided to extinguish the metal particles.~~

The relationship between concentrations of the electrolyte and the electromotive force was observed. The electromotive force changed when the electrolyte was replaced with water, alcohol or a mixture of water and alcohol in various mixing ratios. The output voltage was measured when the sample was under atmosphere or in

vacuum.

Almost little change of the voltage or current was detected after a continuous discharge of 100Ω for 48 hours by means of the copper sulfide generator. When almost all of the excessive copper sulfide was supposed to be consumed and a large amount of current of $2000mA/12cm^2$ was applied for a short time of about 3 seconds, the voltage change was not detected, however, the current increased almost one hundred times. The rate of precipitation of copper at the two electrodes also was increased. From this experiment, it can be found that the concentration of the electrolyte and the voltage (3-100mV) were contrary to each other. In addition, a changing gap of the voltage was large and the direction of the voltage was reversed by humidity.

From this experiment, almost all of the items set forth prior to the experiments were confirmed. The purpose of the experiment was to determine whether the outputted electric energy was from the electric energy obtained from the electrochemical reaction or from the heat of an object by means of rectifying thermally moving electrons of the minute metal particles on the surface of copper sulfide.

We can notice the following. First, above-described experiment cannot be appropriately explained by the electrochemical theory. Second, copper is precipitated at both electrodes and third, temperature drop is accompanied with current flow. Such phenomenon which is inconsistent with the electrochemical theory and the precipitation of copper at both electrodes are not direct evidences for the conversion of the heat of the object into the electric energy. However, these results imply that the output of the electric energy did not resulted from a consumption of electrochemical materials.

In this experiment, the electrochemical energy sources are copper and sulfide. Combination of copper and sulfide is an exothermic reaction according to a literature, and discharge accompanies an output of heat owing to an internal resistance. An input and output of electrons of semiconductor accompanies exothermic and endothermic phenomena by Peltier effect. However, the amounts of these two heats are the same and these heats do not affect an external system. Accordingly, the conversion of the heat of the object into the electric energy is determined by a relationship of an output current to a temperature drop of an apparatus for outputting the electromotive force. The temperature drop can be simply observed by detecting a change of voltage of a temperature sensor contacting the electrode while alternately applying charge and shutting off electricity. The present inventor observed that the temperature drop was detected during current flow.

From this experiment and other experiments of the present invention, the followings were observed. The output current is connected with the minute rectifying surfaces and the size of the particles is connected with the output voltage. In addition, the direction of the current depends on the P or N conductivity of the semiconductor. Further, there's no energy source on the surface of the semiconductor, however, an energy output was observed. That is, a temperature drop occurred during the current flow. Accordingly, the present inventor concluded that the conversion of the heat of the object into the electric energy is accomplished by a rectifying phenomenon of thermally moving electrons by magnetic energy. Still, the above-described experimental result cannot be explained by the existing modern scientific knowledge.

The present inventor sets the following simultaneous theory for understanding and explaining the observed results.

The simultaneous theory

The simultaneous theory defines the following. In an isolated system in an equilibrium which has a certain number of particles, the probability of having a pair of particles at a boundary at the instant when they randomly enter and exit the boundary, depends on an area of the boundary.

The explanation on the simultaneous theory

A unit room separated into A and B sections by an imaginary central boundary is filled with n number of gas molecules. The molecules can freely pass the boundary. When a molecule moving from section A to section B presents at the boundary at an instant when a molecule moving from section B to section A is at the boundary, the room is in equilibrium and the pressures of sections A and B are the same. The probability instantaneously having a pair of molecules at the boundary is defined as a simultaneous probability, and the equilibrium system is represented as a space having one (1/1) simultaneous probability. In contrast, a space having zero (0/1) synchronism probability represents a non-equilibrium system which has no molecule moving in the counter direction of a molecule at the imaginary boundary. In order to help understanding the theory, a system having an enlarged boundary by n times is assumed. At equilibrium state, the simultaneous probability of a room having the enlarged boundary is one (1/1). However, when only one molecule is present in one divided section of the room and no molecule is moving in the counter direction of this

molecule, the room is in a non-equilibrium state and has an simultaneous probability of zero (0/1).

In a common equilibrium system, a limited number of particles are present in the system. However, it is also conventionally supposed that an unlimited number of the particles occupy a limited space in many equilibrium states. That is, an infinite number of particles are still present in a smallest possible space that we can imagine in a system, although such system may not correspond with reality. The simultaneous theory excludes such a special case and assumes that equilibrium systems have limited number of particles in a limited space.

A system in equilibrium is definitely present nature. However, portions within the equilibrium system are not in state of equilibrium. Until now, many problems related to equilibrium have been solved while ignoring these portions. However, according to the simultaneous theory, these portions became a key for explaining the newly discovered phenomenon.

By the second law of thermodynamics, it is regarded that a portion within an equilibrium system also is in a state of equilibrium. However, by the simultaneous theory, a portion which has simultaneous probability of zero (0/1) is present in a system having the simultaneous probability of one (1/1). In addition, various values of discontinuous or continuous probabilities are determined by space and number of the particles. At this time, in order to clarify the simultaneous theory and to make terms consistent, references will be made, such that gas molecule is defined as an actor, a space in which the actor controls is defined as a spacor and an apparatus installed in the space

is defined as a funcor.

An important factor to be considered is the following. In an equilibrium system, portions of the system may be in equilibrium, and the degree of non-equilibrium increases as the size of the portions decreases. This phenomenon is defined by the simultaneous theory.

In addition to the above-described example, various cases to which the simultaneous theory can be applied is illustrated by the following. A P-N junction of a semiconductor of an isolated equilibrium state, entering and exiting of electrons through a rectifying boundary of a metal and a semiconductor, entering and exiting of free electrons through an imaginary boundary in a metal or a semiconductor, entering and exiting of heat through an imaginary boundary in an object, entering and exiting of liquid molecules through an imaginary boundary in a liquid, and the like can be exemplified. Some concrete examples are as follows.

Sub a6

1. Even though a surface of water of an isolated lake makes rippling waves, mean water level of the lake is considered to be same and the lake is considered to be in equilibrium. Through the whole lake, the amount of water above an absolute horizonal plane and that below the absolute horizontal plane are same and the water above and below the horizontal plane are in equilibrium. When a molecule of water ascends above the horizontal plane, another molecule of water descends below the horizontal plane at some other place in the lake. Thus, the water level is kept constant. However, when the surface is divided and observed, and a surface having a peak of the wave is observed, a heap of water ascends without having the same amount of water

Sub a5 (Cont'd)

descend in this divided area. That is, the peak and trough of a wave are not always present in one space. This space has simultaneous probability of zero (0/1). Even though the lake is collectively in equilibrium, a local portion which is not in equilibrium is present. When the space of the local portion is enlarged, this portion approaches to the equilibrium state.

Sub a6

2. A seawater level on the earth has a constant mean water level because the amount of water evaporating and precipitating are the same. When the seawater keeps the mean water level, the two amounts are the same and the state of equilibrium is maintained. However, at some places, the amount of water evaporated is larger and at some places, a heavy rainfall pours. At an entrance of a river, a large amount of water inflows. That is, even though the seawater is collectively in equilibrium, each portions are not in equilibrium.

3. Total energy received from the sun and total energy emitted from the earth are in equilibrium. However, input and output of energies from portions of the earth are not same and are not in equilibrium.

Above-described examples are readily apparent examples. However, more abstract and symbolic examples are given below to aid further understanding of the simultaneous theory.

4. During the metabolism of a living thing, the input and output are not always the same. However, total sum of the input and output during its lifetime becomes the same and approaches to the equilibrium. This implies an intrinsic nature of living things progress from life to death.

The simultaneous theory and the second law of thermodynamics

There are various ways for describing the second law of thermodynamics. Among them, one typical definition is the following. "An isolated system which is in non-equilibrium state proceeds toward equilibrium state, and the equilibrium state is maintained if no external energy is supplied, and this process is irreversible."

Sub a2

~~For example, when a metal and a semiconductor contact to form a rectifying surface and a voltage is not applied, an exchange of electrons occurs only for an instant and an equilibrium state is achieved after metal and semiconductor establish Fermi level. At this time, the number of electrons coming in and out of the rectifying surface are the same and no resulting voltage change is obtained. The voltage between two terminals of the boundary surface is called a contacting electricity which is generated by both materials and not discharged. This rectifying surface is in equilibrium and does no work with respect to an external system.~~

Definition on rectifying phenomenon and its explanation will be briefly given below. "Rectifying phenomenon occurs when a difference of electrons moving through a rectifying boundary surface exists due to a degree of difficulty of electron movements caused by a difference between a low barrier generated when a voltage of forward direction is applied and a high barrier generated when a voltage of reverse direction is applied."

According to this definition, the voltage of the reverse direction is an essential condition. The height of the barrier generated by applying the voltage in forward or reverse direction is an inherent characteristic. Accordingly, the occurrence of the

rectifying phenomenon is determined by the presence of the voltage in reverse direction with respect to the applied voltage to the rectifying surface.

The further elaboration of simultaneous theory and its relation to the second law of thermodynamics will be described in more detail. A state when a pair of electrons entering and exiting the rectifying surface of an isolated and equilibrium system simultaneously exists at a boundary at the same time, is a necessary and sufficient condition which induces no change of charge at both sides of the boundary regardless of number of randomly moving electrons. This condition can be rephrased in other words, that is, a state when a pair of electrons having counter phases exists at the rectifying surface at the same time. An equilibrium starts from this point according to the simultaneous theory, and the probability of such state increases by an area of the rectifying surface at a given number of particles. However, according to the second law of thermodynamics, the probability is constant regardless of the area.

~~Thus, when indefinite amount of particles are present in a space, the simultaneous theory and the second law of thermodynamics render the same result. However, when the number of particles present in the space is limited, the simultaneous theory and the second law of thermodynamics give completely different result. Accordingly, the one which closely correspond to the actual reality gives and accurate result. When the rectifying surface is large and unlimited number of free carriers are present at the surface, the system is in equilibrium by both theories.~~

Sub A8

However, when the rectifying surface is very minute, results obtained by the simultaneous theory and the second law of thermodynamics are as follows. According

to the second law of thermodynamics, the minute surface maintains equilibrium as with the large surface and has no external effects. However, according to the simultaneous theory, the rectifying surface could be a minute space having only one electron or a number of electrons making both directional movements. When only one electron is present in the minute space, the probability of a pair of electrons being present at the boundary is zero. When two electrons are present in the minute space, the probability of the two electrons moving in counter direction being simultaneously present at the boundary is also nearly zero.

Now, the phenomenon obtained by a rectifying surface having one electron will be discussed. The following was stated earlier. When a pair of electrons entering and exiting the rectifying surface at equilibrium are simultaneously present at the boundary, no change in charge exists at both sides of the rectifying surface.

When one electron makes a random and both counter directional movements without the presence of another electron making reciprocal movements, a continuous change in charge is generated at both sides of the rectifying surface. Similarly, when several electrons move around the rectifying surface, the probability of keeping the same degree of charge at both sides of the rectifying surface is small. When the number of electrons increases, the simultaneous probability increases and the difference in charge between both sides of the rectifying surface decreases.

When a semiconductor and a metal contact to form a rectifying surface, a state of condenser is obtained and a voltage also is obtained according to their relationship to the condenser. Referring to a common relation of $V=[L/(\varepsilon^*S)]^*q$, voltage and area are in

inverse proportion. In this relation, V represents voltage between them, S represents contacting area, L represents distance between them, q represents charge of an electron and ε represents dielectric constant. For the rectifying surface formed by the semiconductor and the metal, there may be some discrepancies in utilizing the relationship. However, the inversely proportional relationship between the area and the voltage is the same.

The values are calculated and represented as in a graph A and in Table 1. At this time, L=31Å, $\varepsilon=8*8.855*10^{-12}$ and $q=1.602*10^{-19}$J. When the rectifying surface is circular, V=8.9 volt when the diameter of the circle is 10Å, V=2.2 volt when diameter is 20Å, and V=0.35 volt when diameter is 50Å. This means that when one electron enters and exits a minute rectifying surface having a diameter of 50Å, a voltage change of 350mV is measured. When defining the rectifying phenomenon, the generation of a reverse voltage is a necessary and sufficient condition. Even when the rectifying surface is very small and only one electron occupies the surface, rectifying is possible if the electron impacting the surface goes over a barrier of forward direction to give rise to a barrier of reverse direction.

This is an interpretation on the minute rectifying surface according to the simultaneous theory. Further, when an electron impacting the rectifying surface obtains energy by heat of an object, rectifying phenomenon also occurs. An electron has a mean energy value of about kT (0.026eV) at an ambient temperature and very few electrons ever have an energy value of about 5kT. According to a relation of $W = (1/2)qv = (1/2)cv^2$ (refer to graph B), voltage values of about 50mV at kT (=0.026 eV),

100mV at 2kT, 150mV at 3kT, 200mV at 200kT and 250mV at 5kT can be obtained. In this relation, W represents energy of a condenser, q represents charge amount, c represents capacity, v represents voltage.

Sub a9

~~It is~~ difficult to describe the operational principle of the rectifying surface. The above-described phenomenon ~~is obtained~~ when there is a small number of electrons.

In a space which has no probability of having a particle in a counter direction, only a single molecule, one electron or one carrier is present. In addition, it can be assumed that all of the particles have the same phase. For example, a course of water flowing toward one direction, a blast of wind, a bundle of exploding and burning gas, a gushing vapor having a high pressure, free carriers in a semiconductor (diode, transistor, etc.) having one directional phase by an applied voltage, charges in a field, charges moving in a magnetic field, and the like can be illustrated as a space having zero simultaneous probability in which no particle having the counter direction is present.

At this time, one common point is that all of the particles have kinetic energy. When the particles in the space of which simultaneous probability is zero, are supposed to have the kinetic energy, electrons in a minute rectifying surface of which simultaneous probability is zero are supposed to have no thermal energy but kinetic energy. In other words, the energy can be interpreted as an irregular alternating power and this irregular alternating power is supplied to the rectifying surface to output a direct power. However, this phenomenon is contradicted by the second law of thermodynamics.

In conclusion, for a space having a large area, the simultaneous theory and the

second law of thermodynamics provide the same result. However, for a space having very small area, they provide different results. The verifications of the results should be determined by an experiment since all possible extensions of the second law of thermodynamics have not been completely verified as of yet. And the experimental result supports the simultaneous theory.

Function of particles

Two functions of the minute particles are described above. Because the size is very small, the electrons do not simultaneously enter and exit rectifying surfaces, the conversion of energy of thermally moving electrons into the irregular alternating energy is accomplished and the amount of the irregular alternating potential becomes large as the size of particles decrease. Refer to the equation concerning a condenser, graph A in FIG. 1 and Table 1 below.

Table 1

	A(X)	B(Y)
1		8.926
2		2.2315
3		0.9917778
4		0.557875
5		0.35704
6		0.2479444
7		0.1821633
8		0.1394688
9		0.1101975

10		0.08926
11		0.0737686
12		0.0619861
13		0.0528166
14		0.0455408
15		0.0396711
16		0.0348672
17		0.0308858
18		0.0275494
19		0.0247258
20		0.022315
21		0.0202404
22		0.0184421
23		0.0168733
24		0.0154965
25		0.0142816
26		0.0132041
27		0.0122442
28		0.0113852
29		0.0106136
30		0.0099178

Another important function will be described below.

Sub a10

~~When the~~ simultaneous theory is supposed to be true, an irregular alternating potential is generated by electrons entering and exiting a ~~minute rectify~~ing surface. This

Sub a10 (cont'd)

generation is originated from the kinetic energy of electrons by heat. The rectifying phenomenon is accomplished when the rectifying condition is satisfied. The rectifying phenomenon occurs when there is a difference of electrons entering and exiting the rectifying surface which is caused by a heightened barrier by an externally applied voltage and a low barrier of forward direction. The rectifying condition is an externally applied voltage. When a minute rectifying surface is allowed, a current amount will be very weak. A plurality of minute rectifying surfaces arranged in parallel will give the same effect with a rectifying surface having one large area. At this time, the rectifying phenomenon of the thermally moving electrons does not occur by the simultaneous theory. However, when minute metal particles are dispersed on a surface of a semiconductor, and when each particle is electrically insulated, each particle maintains its own independent rectifying reaction. A number of metal rectifying particles are connected with a collecting metal surface with a tunnelling effect layer (in the experiments, tantalum oxide layer, aluminum oxide layer or water was utilized) between them. Then, the particles are combined in parallel to accomplish a large rectifying surface of which rectifying condition by the simultaneous theory is satisfied. The minute metal particles have irregular phases and periods. However, the rectifying direction of the semiconductor and the metal particles are the same. Thus, an effective rectifying reaction is implemented and about 20 Amperes per cm^2 or above of current could be obtained with rough experimental apparatuses. The resistance of the semiconductor has been disregarded. The collecting metal surface contacts the semiconductor where the metal particles are not present with the tunnelling effect layer between them.

Sub a10 (cont'd)

~~However, no discharging~~ occurs because a reverse direction is obtained with respect to the semiconductor owing to the rectifying structure.

Examples of generating energy from non-equilibrium portion present in an equilibrium system

Sub a11

As described above, when the rectifying surface is divided into minute regions, an aggregate of minute rectifying surfaces in non-equilibrium state is obtained. The minute rectifying surface have the simultaneous probability of zero (0/1). When independent rectifying apparatus is installed for each rectifying surfaces, energy can be acquired from the space in non-equilibrium state. Since the non-equilibrium state is continuously maintained by an externally supplied heat, energy can be constantly obtained. The value of the energy is determined by the kinetic energy of electrons. This is the result obtained by the experiments according to the simultaneous theory.

The rationality and propriety of the simultaneous theory will be described in more detail by referring to hydroelectric power generation as a clear example. First, an equilibrium state of the surface of seawater will be described. When a water molecule departs from the seawater level, in some other place a water molecule returns to sea to maintain the seawater at equilibrium. The departing and returning water molecules are represented as a pair of particles entering and exiting a boundary. The probability of the presence of the pair of particles at the surface of the seawater is collectively and nearly 1. When the seawater is divided into segments, the probability of the presence of the pair of particles at the surface of the seawater decreases.

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~~However, in some places, a larger amounts of water evaporates and at som~~

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~~places such as an entrance of a river, a larger amounts of water enters the sea. From these kinds of non-equilibrium state, that is, places having low simultaneous probability, energy can be obtained. Most of hydroelectric power plants are installed where water inflows into the seawater. Energy can be continuously obtained until an external and thermal energy is supplied and al long as non-equilibrium state is maintained. At this time, the amount of energy is determined by a potential energy of water. The size and installing scale of the hydroelectric power plant are determined by the amount of water. That is, an actor and a funcor (installing scale of the plant) in a spacor are appropriately realized.~~

When comparing the rectifier of the present invention with the hydroelectric power generation, the following points are similar. They collectively maintain equilibrium and are composed of portions in non-equilibrium. Appropriate installations are provided with the portions in non-equilibrium and having the simultaneous probability of zero (0/1). Energies can be obtained during the progression from non-equilibrium states to equilibrium states. The non-equilibrium states are maintained by externally supplied energy to obtain energy continuously. Electrons move toward one direction by a rectifying reaction while the water vapor generated from the seawater moves toward the upper stream of a dam. Electrons make irregular and periodic movements. This is similar to a periodicity of rain. In addition, the kinetic energy of thermally moving electrons is converted into potential energy. A barrier of the rectifying surface generates the energy while a bank of the dam generates the potential energy of water.

The most important points are a cause of a head of water and a voltage

difference. In order to satisfy the principle of the conservation of energy, the causes are externally supplied energies. The difference of the water levels on both sides of the dam is externally caused by heat of the sun and a rising current of air. When examining the movement of the electrons, the kinetic energy of the electrons is obtained from their impact with other electrons or atoms to receive external energy. That is, electrons go over the barrier of the rectifying surface to acquire potential energy by an external thermal energy.

Well known Brownian motion of a pollen is accomplished by a collision with water molecule. If two water molecules having counter directions collide with the pollen at the same time, the pollen maintains its stationary position. This phenomenon does not occur for a petal. The simultaneous probability decreases as the particle size decreases to the pollen having the size near to the water molecule. That is, the water molecule actor influences the pollen (a funcor) approaching a spacor. If a bar is connected to the pollen and an apparatus for generating an alternating current according to the vibration of the bar can be installed, an electric energy can be obtained. Smaller particle than the pollen will make more effective vibration because the simultaneous probability of impacting water molecule will be further decreased. At this time, the kinetic energy of the water molecule will be converted into an electric energy and the kinetic energy of the water molecule will be decreased while accompanying a temperature drop. This induces a temperature difference with surroundings and inflow of heat. When a hot wire receives the generated power, the wire emits heat. This heated portion and a cold portion where the kinetic energy of the water molecule has been decreased, will have a

temperature difference.

With this structure, a heat loss caused by a friction is converted into the kinetic energy of the water molecule. That is, remaining heat which is not converted into the electric energy remains as heat to obtain an energy conversion efficiency of 100%. If this apparatus is isolated, the decreased amount of entropy from the generation and the increased amount of entropy from the flow of the heat is same and thus no overall change in entropy is observed. There's no temperature drop if no energy flows out to external system. If energy flows out to the external system, corresponding heat should be supplied into the system. Otherwise, the temperature of the system drops.

The generating system utilizing the Brownian motion of the pollen is an ideal system. However, its theoretical propriety is sufficient. It is reasonable that a space in which simultaneous probability is zero (0/1) and which is in non-equilibrium is present in an equilibrium system, and energy can be obtained from this system. However, people who are familiar with the second law of thermodynamics will find it difficult to accept the generation of temperature difference and the progression from the equilibrium state to the non-equilibrium state without a supply of an external energy. The present inventor acknowledges the second law of thermodynamics, however, also believes in the generation of the temperature difference without any supply of an external energy as illustrated by the Brownian motion of the pollen. The simultaneous theory related to this portion will be described in more detail.

A lake is divided into two sections having a slightly different water level by a floodgate. When the floodgate is opened, water flows from the section having higher

water level to the section having lower water level. When no water flows between two sections, the second law of thermodynamics defines this state as an equilibrium. Heat flows from an object having higher temperature to an object having lower temperature. When two objects have the same temperature, this state is also in equilibrium.

Even though rippling waves are rising, the two sections of the lake are regarded to be equilibrium because they have the same mean water level. When there is no difference in the water level or in temperature for two objects, no energy can be obtained. The second law of thermodynamics concludes that no energy can be obtained without water level difference or temperature difference.

From the standpoint of the simultaneous theory, energy can be obtained from the difference in the water level or temperature as well, however, energy can be also obtained from the rippling wave portion of the lake. If a floating body having a size similar to the rippling wave can be installed, kinetic and electric energy can be obtained. The size of the floating body should be small enough to make a collision with a peak of the rippling wave. If the floating body is too big to make a collision with a number of peaks and troughs of the waves, no kinetic energy can be obtained. From a large rectifying surface through which a number of electrons enter and exit, one cannot obtain energy. when the number of peaks of the waves impacting the floating body is set m and the number of troughs of the waves is set as n, m = n+1. The most efficient kinetic energy can be obtained when n=0. As the size of the floating body increases, the energy efficiency decreases. When the peak of the wave is considered as an actor and the space occupied by the wave is considered as a spacor, the energy of the actor is

most efficiently transferred to the floating body (funcor) when the size of the floating body is within the spacor.

A body having heat indicates the presence of waves of atomic vibration. If an appropriate apparatus having the wave size can be installed, electric energy can be obtained by rectifying thermally moving electrons. The water level of the lake has no relations to the generation of the rippling waves. Meantime, electrons make thermal movements even at low temperature. After closing the floodgate, one can obtain power from the energy of the waves generated at both sections. Water from one section can be transferred to the other section by utilizing this power to make a water level difference. In a body, a temperature difference can be obtained by the same manner because the origin of the heat in the body is external energy.

The waves on the surface of the water or the thermal movements of electrons in a conductor is not considered in the explanation of equilibrium on the water level or the heat of the body by the second law of thermodynamics. The energy is not considered to be present in the system. When the floodgate is closed after the two sections are at equilibrium with presence of no wind, the lake is an isolated system. A slight water level difference can be accomplished by utilizing remaining energy of the waves. Similarly, the heat in the body can be considered as a stored energy. By utilizing this energy, thermally moving electrons can be rectified to obtain power and a temperature difference. Same principle can be applied in obtaining energy from the waves of the lake and from the waves of vibration of electrons entering and exiting the rectifying surface. The wave is visible, however, the vibration of the electrons can not be

perceived by our senses.

Heat is a type of energy. When we intent to obtain another energy from the thermal energy a cold heat source is needed. Accordingly, it has been known that a conversion from the heat into another energy is not possible. The generation utilizing the motion of the pollen is fundamentally acceptable. When the size of the pollen is near the water molecule size, more efficient energy generation might be obtained. In this system no cold reservoir is present. Accordingly, the efficiency is 100% and it is theoretically possible at above 0°K. This generation has a relation of one to one correspondence with the generation utilizing the thermally moving electrons. The most efficient system in obtaining kinetic energy for the hydroelectric power generation, the waves of the water and the Brownian motion of the pollen, is a space having the simultaneous probability of zero (0/1) present in an equilibrium system. By utilizing an appropriate apparatus corresponding to the space, energy can be obtained.

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When neighboring spaces A and B have a water level difference, the water in space A do not occupy space B at the same time. When a temperature difference is present between spaces A and B, the temperature of space A do not affect the temperature in space B at the same time. It is believed that energy can be obtained from the water level difference or the temperature difference. At this time, the simultaneous probability of the water level or temperature of spaces A and B is zero (0/1). The states of spaces A and B is liable to change according to time and energy can be obtained from a space having the simultaneous probability of zero (0/1). Thus, concept utilized in the second law of thermodynamics can be reasonably adopted by the

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simultaneous theory without any conflict.

Most power sources are energy outputted from an actor, a spacor and a funcor installed in the spacor in a space having the simultaneous probability of zero (0/1). For example, in a space in which an actor of an exploded and burning gas pushes a funcor of a piston in a spacor of cylinder, particles move toward one direction. Various energy outputting apparatuses utilizing wind force, water power, vapor pressure, electric power, and the like consist these components. For a rectifying surface into which an alternating voltage is applied, the phases of free carriers become the same by the voltage and the rectifying surface become a funcor positioned in a spacor occupied by the free carriers. This example is very similar to an example containing a minute rectifying surface. The actor has a single phase and the funcor is the rectifying surface. The single phases are obtained by the applied voltage or by reducing a space. The shapes and the functions are the same for both examples.

For the hydroelectric power generation system, an equilibrium system is established when its starting point meets its ending point. In this equilibrium system, a huge hydroelectric power generating plant is installed at a non-equilibrium portion. In view of the time, it takes to move a continent and a large area such as the surface of the earth, the lifetime of the plant is considerably short and its size is very small. From the space having the simultaneous probability of zero (0/1), energy can be obtained. This fact can be a universal truth.

When considering a faint of radiant energy originated from a mass and which disappears into the universe returns as a mass, a huge equilibrium can be

conceptualized. For this case, fission or fusion becomes a phenomenon in a space having the simultaneous probability of zero (0/1). The fact that energy can be obtained from heat, the energy and the heat can be considered as an equality. In regard to the fact that energy and mass are considered as an equality, the mass and the heat could be an equality.

The hydroelectric power generation is already put to practical use. The utilization of waves is currently under research. The utilization of the kinetic energy of a liquid molecule seems distant because an apparatus (funcor) corresponding to that size cannot be manufactured. However, when examining a space in which the simultaneous probability of free carriers in a contacting surface of a semiconductor and a metal is zero (0/1), the following can be accomplished. A control of a density of free carriers in a semiconductor, a control of the size of metal particles, selecting semiconductor material, a control of a rectifying characteristic between a semiconductor and metal particles, and the like can be illustrated. The present invention utilizes these items. The conversion of the thermal energy into the electric energy by means of rectifying thermally moving electrons is confirmed by repeated experiments of the present invention.

When comparing with the rectifier of the present invention with a solar battery, 1/5 times of voltage and 20 times of current (experimentally, 500 times was obtained considering area) produces about 4 times of output power. However, the rectifier is not dependent on the area. The apparatus can be installed as a thin layer form in three dimensions and several tens of times of output power per cubic volume can be obtained. The heat of an object in an ambient temperature is an energy source and heat is

continuously supplied from surroundings. The apparatus is operable at a high temperature and a cooling is possible while collecting energy. The one skilled in the art can easily implement the suggested experiment by the present inventor.

The constitution of the apparatus according to the simultaneous theory exists in wide variety. Various methods can be applied for obtaining a structure having the simultaneous probability of zero (0/1) in contacting metal and semiconductor particles, in dispersing metal particles contacting both P-N junction, in applying minute particles onto one of P-N junction, in designing P-type and N-type serially.

By considering the above, a basic structure of an apparatus for rectifying thermally moving electrons can be accomplished as follows.

(1) A barrier layer such as water, various conducting solvent and electrolyte, a resistor, conductive plastic or a tunnelling effect layer is formed on a plate of a collecting electrode. (2) Minute metal particles which has an excellent rectifying characteristic with a semiconductor and a uniformed size, as determined by an electron energy, are uniformly distributed on the barrier layer in high density. (3) A semiconductor layer having the same density with the metal particles and contacting the minute metal particles is formed. Preferably, P-type semiconductor in which only acceptors are present or N-type semiconductor in which only donors are present is utilized. Materials having a large density difference between two kinds of carriers can also be preferably utilized. (4) An ohmic layer is formed on the semiconductor layer. (5) A metal plate contacting the ohmic layer is formed. These basic structure can be modified in diverse manners.

FIG. 1 is a cross-sectional view of a rectifier of thermally moving electrons according to an embodiment of the present invention.

On the surface of a first metal layer 10, an electron movement barrier layer 12 is formed. On the electron movement barrier layer 12, a minute metal particle dispersed layer 14 is formed. The metal particles are regularly and uniformly dispersed in one layer. A semiconductor layer 16 and an ohmic layer 18 are sequentially formed on minute metal particle dispersed layer 14. Thereafter, a second metal layer 20 is formed on the ohmic layer 18.

FIG. 2 is an apparatus for converting thermal energy into electric energy according to an embodiment of the present invention.

The rectifier of thermally moving electrons is installed in a vacuum chamber 30 and air in the chamber is exhausted to create a vacuum. The external surface of the vacuum chamber is insulated and earthen by an earth line of a shield cable 40. An outer case of vacuum chamber 30 is connected to a signal line of shield cable 40 through a capacitor C to remove external noise.

The rectifying apparatus of thermally moving electrons for experiment is constituted as follows.

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A semiconductor sample (28mm x 8mm x 4mm) of a eutectic body of Cu_2S-CuS-Ag_2S was prepared. One surface of the sample was ground to form a mirror shape and a semiconductor layer 36 is formed. The ground surface was ground by means of a copper bar and rubbed by means of a paper to heat the surface. The other surface of the sample was fixed onto a metal plate 32 (stainless steel) by utilizing an

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adhesive 34 (silver paste). An aluminum plate having a thickness of 0.2mm was cut to form about 20° angle to form a tip. the tip was heated to form an aluminum oxide layer on the surface of the tip and to obtain an aluminum needle 38. The tip was fixed onto the mirror surface and metal plate 32 is connected to a detecting apparatus 50 through a shield cable 40.

After the connection, voltage of several micro volts was detected by the detecting apparatus (the aluminum electrode was negative potential). With the lapse of time, the voltage gradually decreased. After 30 minutes, the polarity was changed and the aluminum electrode became positive potential. Then, the voltage was increased and detected value was 100mV after 2 hours, 200mV after 3 hours and 250mV after 4 hours.

Current was detected by replacing a voltmeter with an ammeter of which inner resistance was 1000Ω. Current value was 150μA for about 90 minutes and was gradually decreased. The rate of the decrease was accelerated.

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The voltmeter was connected again. Voltage was lowered and the value was several mV. At this time, no mark was found at the contacting point of the mirror surface and aluminum needle 38. The above-described experiment was implemented at an ambient conditions.

The observed voltage value could not be detected during a number of experiments in which the silver paste was not utilized. However, the apparatus was not a simple chemical battery. Electromotive force was obtained when the minute metal particles were dispersed on the surface of the mirror surface of the sample, however, it

was not obtained when the particles were impregnated into the sample. The generation of the electromotive force was observed by utilizing various semiconductors and the minute metal particles, though the values of the electromotive forces was different.

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An Si sample (28mm x 8mm x 4mm) was prepared and platinum (Pt) minute particles were rubbed to manufacture a rectifier. After observing for 2 years, the present inventor concluded the followings. The minute metal electrode was not consumed (as a chemical battery) and the voltage difference was observed by humidity. The decrease of the current values according to time was due to an oxide layer on the surface of the Si sample. When an oxide layer is between the minute metal electrode and the Si surface, the same result was obtained. This experiment was implemented at an ambient conditions.

The minute metal particles showed tendency to impregnate into semiconductor layer 36 for the sample of the eutectic body of Cu_2S-CuS-Ag_2S and its impregnation speed was increased when the humidity was high. After rubbing the copper bar against the sample, the minute copper particles were dispersed on the surface to generate a sufficiently large electromotive force. However, the humidity in the laboratory was high and some minute particles were impregnated into the samples, thereby lowering the voltage.

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The number of the minute particles were decreased and reached to an optimized number to give the highest voltage value. Then, the voltage was decreased according to the decrease of the number of the minute particles. After supplying the current, the voltage was decreased and then recovered. This implied that the result was affected by

humidity and characteristics of chemical battery.

In order to verify the effects of humidity, the experiment was repeated in vacuum and air. The directions of the electromotive forces were opposite to each other according to the environment. The samples illustrating a large electromotive force in air also illustrated a large electromotive force in vacuum. Each sample illustrated two opposite directional electromotive forces and the direction was determined by the environment. The values were different by about 20 times when the experiment was conducted under about 10^{-3} torr and about 10^{-6} torr.

The impregnating speed of the minute particles was remarkably reduced and the output current was kept constant. No characteristics of chemical battery were illustrated. In vacuum of which pressure was constant, the value of the output current was kept constant for several days.

Under 10^{-6} torr, a voltage of 0.8mV and a current of 0.6μA were obtained (the resistance of the ammeter was 1000Ω). A precise value of contacting area of semiconductor layer 36 and aluminum needle 38 could not be calculated but it was roughly about 5μm x 5μm. Assuming this area, the current per area was 0.6μA per $25\mu m_2$ and 2.4A per cm^2.

When Si-solar battery was shorted, a current of 0.02A per cm^2 was obtained. For a mercury battery having diameter of 11.6mm and height of 3.4mm and having a maximally permitted current of 0.0025A, an electric capacity of 0.07Ah and a discharging current of 2.4A, the current flowed only for 105 seconds. The size of the sample utilized in the experiment of the present invention is similar to mercury battery.

When this sample discharges a current of 2.4A for three days (practical discharging time is longer), the electric capacity of the sample was 2568 times of that of the mercury battery.

It can be confirmed that the rectifier of thermally moving electrons according to the present invention is different from the conventional chemical battery.

The present inventor also considered the following metal.

When a P-type semiconductor and a metal layer are contacting and no potential difference is present between them, electrons enter and exit a contacting surface without a barrier and the number of entering and exiting electrons are the same. However, when one of the metal layer or the semiconductor layer is made of minute particles, different result is obtained. When the minute particle accepts an electron, the particle shows higher potential. This potential proportionally increases according to the decrease of the size of the particle. (Refer to graph A and Table 1)

When a P-type semiconductor contacts with minute metal particles and an electron moves from the metal particles to semiconductor layer 16, the minute metal particle presents higher potential against P-type semiconductor layer 16. At this time, the potential difference is forward direction and the electron readily moves toward the metal minute particles. However, when an electron moves from P-type semiconductor layer 16 to the metal minute particle, the minute metal particle presents lower potential and this potential difference is a reverse direction. Therefore, the electron cannot move toward P-type semiconductor layer 16 in vacuum. That is, a minute rectifying surface can move electrons in one direction.

When the semiconductor is N-type, the opposite phenomenon occurs. If the size of the minute particle is enlarged, the number of entering and exiting electrons becomes similar. Thus the voltage difference becomes small. If the size of the particle is too small, the voltage difference from one electron is too large and the electron cannot move, thereby giving no electromotive force.

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~~Practically, the number of particles are present and the phases and vibration periods of the particles are respectively independent. These electrons are guided into one direction in the present invention. When the metal particles and the metal surface are one body, this effect cannot be obtained.~~

The rectifier of the present invention comprises a metal layer 10, a barrier layer 12, a minute metal particle dispersed layer 14 and a semiconductor layer 16 and irregularly rectifies thermally moving electrons into one direction to convert thermal energy of an object into electric energy.

Industrial Applicability

As described above, a conversion of thermal energy into electric energy by rectifying thermally moving electrons between a minute metal particle dispersed layer and a semiconductor layer, is possible according to the present invention. Thus, electric energy can be obtained without input from any other external energy. This can be an energy source of the next generation.

When minute electrodes of from several to twenty nanometers having uniform shapes and sizes are evenly dispersed on a semiconductor and if its impregnation into

the semiconductor can be prevented, an apparatus having a lasting lifetime and almost the same quality with the present internal-combustion engine can be manufactured. An automobile running by heat supplied from air and a computer having an unlimited lasting power can be manufactured.

In a time when demand for miniaturized and portable power sources are increasing, the realization of lasting and pollution free power source will revolutionize and have tremendous effect on energy industry.

Modifications to the rectifier of thermally moving electrons of the present invention can be easily achieved by one skilled in the semiconductor field. Various methods can be utilized to obtain a structure in contacting metal and semiconductor particles, in dispersed metal particles contacting both surfaces of P-N junction, in applying minute particles onto one of P-N junction, in designing P-type and N-type serially, in manufacturing an integrated shape, in omitting an ohmic layer, and the like. A common feature of these structures is an aggregate of rectifying surfaces of minute particles having the same electron rectifying directions.

While the present invention is described in detail referring to the attached embodiment, various modifications, alternate constructions and equivalents may be employed without departing from the true spirit and scope of the present invention.